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Effects of different types of adult language input on vocabulary learning and language productivity in children with expressive language delay

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Effects of different types of adult language input on vocabulary learning and language productivity in children with expressive language delay

by

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Abstract

Effects of different types of adult language input on vocabulary learning and language productivity in children with expressive language delay

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Abstract: The purpose of this study was to assess the differential effects of grammatical and telegraphic input on word learning and language productivity in children with expressive language delays. Two case studies are presented. In Study 1, the participant received focused stimulation treatment over eight sessions. Type of language input (i.e. telegraphic or grammatical) was alternated across sessions. In Study 2, the participant received focused stimulation treatment over 16 sessions divided into two eight-session phases. Language input was alternated across phases. Participant characteristics limited definitive conclusions regarding word learning. Productive language differences during treatment sessions were observed for both participants. Participant 1, who entered treatment with a larger vocabulary and spontaneous production of some word combinations, demonstrated a higher mean length of utterance in words (MLUw) in more of the sessions under the grammatical condition. Participant 2, who demonstrated severe deficits in speech intelligibility, imitated the clinician more often in the telegraphic sessions. Results support the need for improved systematic study of

language input variables in treatment as well as the careful selection of language input protocols based on initial client abilities and treatment outcome goals.

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INTRODUCTION

Language is a commonly cited exemplar of the experience-dependent developmental principle of neuroscience (Kuhl, 2010). The importance of language input on language development in typically developing children has received extensive attention in the scientific literature. Studies commonly employ correlational designs to identify caregiver input factors that are associated with larger vocabulary sizes (Brent & Siskind, 2001; Goodman, Dale, and Li, 2008; Hills, Maouene, Riordan, & Smith, 2010; Huttenlocher, Haight, Bryk, Seltzer, & Lyons, 1991; Weizman & Snow, 2001). This research has identified potential mediators of vocabulary development including input amount, sophistication of vocabulary[1], and contextual diversity. The role of input may be even more significant for children with language learning difficulty. In this context, language intervention strategies typically involve manipulations of adult input to effect change in language learning skills (Camarata, Nelson, & Camarata, 1994; Girolametto, Pearce, & Weitzman, 1996; Hancock & Kaiser, 2006; Robertson & Weismer, 1999). Although simplified and specific input is common to most language intervention paradigms, controversy exists regarding the efficacy of the specific means of input simplification. One perspective supports the use of telegraphic speech, which emphasizes the semantic content of an utterance by reducing its syntactic complexity (Miller & Yoder, 1972). The opposing position stresses the importance of using simplified, but grammatically accurate utterances (Fey, Long, & Finestack, 2003). Little empirical evidence exists to support the use of either input type in intervention with young children.

[1] Sophisticated vocabulary was defined by Weizman & Snow (2001) as "words in general use by the language community that fall outside the 3,000 most common words of English and their various inflected forms".

Telegraphic speech refers to the language used by typically developing children in the earliest stages of word combinations involving simple semantic relations expressed through combinations of content words and omission of functor words (i.e. verb inflections, articles, prepositions), such as "the" or "-ing" (Brown, 1973). Adult use of telegraphic speech within language intervention is based upon the underlying assumption that providing children with telegraphic models yields improved imitation, which will in turn facilitate acquisition (Willer 1974; van Kleeck, Schwartz, Fey, Kaiser, Miller, & Weitzman, 2010). Support for reducing input to facilitate word learning also comes from research that focuses on how young children respond to adult production of vocabulary in isolation (Brent & Siskand, 2001; Plunkett, 2005).

Brent and Siskand (2001) collected language samples from mother-infant dyads every two weeks for six months beginning when the infant was 9 months of age. The frequency with which mothers produced individual words in isolation during the interactions predicted the child's productive knowledge of the words (determined from a parent report measure and a direct observation) at 15 and 18 months. Plunkett (2005) demonstrated a difference in the amount of time 17-month-olds and 24-month-olds spent looking at target images when the vocabulary word was produced in fluent speech or in isolation. The 17-month-olds exhibited shorter looking times when words were produced in fluent sentences, whereas their looking times were similar to the 24-month-olds in the isolated word condition. Both studies provide support for the rationale that syntactically reduced input may be beneficial for young children (under 24 months). Clinical researchers suggest that this benefit may extend to children who are chronologically older, but present with expressive language delays characterized by using predominantly single words or are transitioning to two-word productions (see van Kleeck et al., 2010).

An understanding of the role of syntactic cues in typical language development motivates the use of grammatical input in language intervention. Prior to producing grammatical morphemes in speech, typically developing children demonstrate attention to functor words and an awareness of the linguistic contexts in which they can be used (Gerken & McIntosh, 1993). Attention and awareness to such cues underlies an important strategy that has been described to explain how children learn words within a stream of speech: grammatical bootstrapping (Bedore & Leonard, 1995). Grammatical bootstrapping denotes a process in which individuals utilize the syntactic frames around a word to facilitate word learning. For example, Golinkoff, Hirsh-Pasek, and Schweisguth (2001) found that when presented in identical contexts, children at 24 months of age learned novel words as either verbs or nouns depending on the frame in which the word was presented. In addition to signaling separate word classes, syntactic structures can differentiate words within the same class. Carr and Johnston (2001) demonstrated that 3 and 4 year-old children learned different verb meanings in identical contexts when presented with distinct inflections ("-ed" or "-ing"). In a study involving younger children, Arunachalam and Waxman (2010) found that 2 year-old children learned novel verbs as either transitive or intransitive depending on the syntactic frame in which the verb was presented. Thus, provision of adequate syntactic cues facilitates word learning in typically developing children by 2 years of age.

Empirical support for the use of grammatical input over telegraphic input is provided by experimental processing studies in which comprehension and attention to both types of input is measured (see van Kleeck et al., 2010 for review). Results from these studies indicate improved comprehension and attention to grammatical input in typically developing children. The two studies that were assigned the highest grade for internal validity (A) by van Kleeck et al. (2010) assessed visual attention to grammatical

and reduced input in typically developing children (Fernald & Hurtado, 2006; Kedar, Casasola, & Lust, 2006). Fernald and Hurtado (2006) demonstrated that 18-month-old children attended more quickly and more accurately to referents of familiar words produced in grammatical sentence frames than to referents of words produced in isolation. Similarly, Kedar et al. (2006) assessed the attention of 18 and 24-month-old children to referents of familiar words produced within grammatical and reduced utterances. Differences in response latency were observed between input conditions for both age groups; children attended more quickly to referents when the target words were produced using grammatical input. In contrast to results from Fernald and Hurtado (2006), no differences in accuracy (i.e. proportion of time spent looking at the correct referent) were observed across input conditions. In addition to inconsistency in results, two major limitations to these studies restrict their application to vocabulary learning in children with expressive language delays. Both studies examine processing of only familiar words and their referents, and therefore do not necessarily reflect the role of grammaticality on processing of novel words. In addition, neither study included children with language impairments. Evidence of processing preferences in children with cognitive delays is unclear (Larson, 1974; Page & Horn, 1985); research to date has not included children with language delays in the absence of cognitive impairments.

While correlational evidence and processing studies have implications for clinical intervention, it is important to test these treatment variables with children with language impairment. Language learning differences inherent to this population may require that clinicians manipulate language input from what is most helpful for typically developing children. Few intervention studies to date have directly compared language production outcomes for treatments differing only in their use of telegraphic or grammatical speech. Loeb and Armstrong (2001) compared productive language outcomes across two slightly

different treatments that utilized either grammatical input or telegraphic input. The grammatical condition involved intensive modeling of subject-verb-object (SVO) utterances during naturalistic play interactions, whereas in the telegraphic condition, clinicians only expanded child utterances using telegraphic structure. Results indicated that both treatment conditions facilitated productive language outcomes (frequency of SVO in the grammatical condition and increases in mean length of utterance in the telegraphic condition). Overall structural differences between the treatment conditions confound the interpretation of language input effects.

Two intervention studies have directly compared language production outcomes for treatments differing only in their use of telegraphic or grammatical speech (Willer, 1974; Wolfe & Heilmann, 2010). Willer (1974) randomly assigned 10 children with intellectual disability and language delay to two treatment groups. Treatment involved elicited imitation of either telegraphic (reduced) or grammatically correct (non-reduced) language models. Results from the study indicated that children in the reduced model group performed significantly better on outcome measures of targeted vocabulary production. No group difference was observed for comprehension of vocabulary targets. Although van Kleeck et al. (2010) calculated large effect sizes for language production in the Willer study, the authors noted small sample size and lack of generalizability as major limitations to the interpretation of the results.

In a more recent study involving a 25-month-old child with expressive language delay, Wolfe and Heilmann (2010) utilized a single subject design to examine changes in target vocabulary production and general expressive language measures across two treatment phases. Treatment utilized focused stimulation techniques, with the two phases differing only in type of language input. Focused stimulation involves the selection of specific vocabulary (or grammatical) targets, which are subsequently modeled at high

intensities within naturalistic interactions without requiring a response from the child (Ellis Weismer & Robertson, 2006). The participant in the Wolfe and Heilmann study demonstrated increased targeted vocabulary within both input conditions, acquiring six words in the telegraphic speech condition versus three words in the grammatical condition. Measures of productive language were also collected during the treatment sessions. The participant was observed to produce more words (both total number of words and total number of intelligible words) in the grammatical condition than in the telegraphic condition. The data suggest that the use of telegraphic speech may facilitate improved vocabulary learning, whereas grammatical input may elicit more frequent use of expressive language, and thus provide more opportunity for recasting and expanding child language. The authors reported data from examining an isolated case study, which limits its generalizability without additional research on a larger sample. Differences in productive language could reflect the order of the treatment conditions (the grammatical phase was completed in the second half of the study) or a differential interest in the toys selected to target the vocabulary words from each phase. In addition, only nouns were targeted in the study. The importance of providing syntactic information for word learning may vary across word classes. That is, provision of cues may be more important for verb learning than for noun learning. Further investigation of the effect of language input on intervention outcomes is warranted.

The American Speech and Hearing Association recommends the use of evidence-based practice in clinical decision making (ASHA, 2005). Their definition requires clinicians to integrate clinical expertise, scientific evidence, and client values into service delivery. Due to the limited availability of empirical research involving intervention outcomes in response to specific language input factors, however, clinicians rely on only a partial understanding of the evidence when making clinical decisions. While

theoretical rationales can provide preliminary basis for using either type of input, additional research of treatment outcomes for children who receive therapy with telegraphic or grammatical language input is important to provide clinicians with the empirical evidence necessary to make best practice decisions.

The current study aims to replicate and expand upon the procedures of Wolfe and Heilman (2010). The study poses three research aims:

1) Confirm the type of language input (i.e. telegraphic or grammatical) that supports improved word learning in children with expressive language delays,

2) Determine whether differences exist between optimal input conditions (i.e. telegraphic or grammatical) for noun and verb learning,

3) Confirm the type of linguistic environment (i.e. telegraphic or grammatical) that facilitates increased language production.

METHOD

PARTICIPANTS

Two pre-school aged children diagnosed with expressive language delay participated in the study. Both participants were referred by a clinical supervisor at the University of Texas Speech and Hearing Center (UTSHC). Inclusion criteria for participation were set to recruit individuals between 27 and 54 months of age with a reported expressive vocabulary of less than 50 words as determined by the MacArthur-Bates Communicative Development Inventories (MCDI; Dale & Fenson, 1996). In addition, participants were expected to score at least 1 standard deviation (SD) below the mean on the expressive language subtest of the Preschool Language Scales-5th edition (PLS-5: Zimmerman, Steiner, & Pond, 2011), and within 2SD of the mean on the receptive language subtest. All participants were required to pass a hearing screening. One of two participants met the full set of criteria based on the initial set.

Participant 1. Participant 1 met all of the criteria except one. He presented with an expressive vocabulary of more than 50 words. Nonetheless, he was included in a pilot study because his vocabulary was still moderately delayed for his age. The participant was 3 years of age at the onset of the study. Assessment results indicated that he presented with a mild expressive language delay characterized by a mean length of utterance below the expected value for a child his age (MLUm of 1.45; expected MLUm of 3.00-3.75) across two 10-minute mother-child play interactions. His expressive vocabulary was assessed by parent report using the MCDI, although the measure is intended for children between the ages of 16 and 30 months. His mother reported an expressive vocabulary of 236 words. Although a standard score could not be obtained for the MCDI, 95% of the 30-month-old children included in the normative sample for the measure produced more than 300 words, with a mean of 518.6 and a SD of 125.2 (Fenson

et al., 2007). Participant 1 demonstrated a productive vocabulary equivalent to the fifth percentile for a child six months younger than he was. Standardized language assessment using the PLS-5 provided support for a diagnosis of a mild expressive language delay (standard score of 81 on the expressive language domain) and receptive language skills in the expected range for a child his age (Standard score of 100 on the auditory comprehension domain). Based on the participant's expressive language profile, the goals for treatment were to expand his vocabulary knowledge and increase the mean length of his spontaneous utterances.

Participant 2. The participant who met all of the initial inclusion criteria for the study was referred following a diagnostic evaluation that indicated a diagnosis of expressive language delay with a secondary diagnosis of phonological disorder. At the onset of the study, the participant was 2 years 6 months of age. The diagnostic evaluation report indicated a productive vocabulary of 17 words as determined by parent report on the MCDI (Dale & Fenson, 1996). Standardized language assessment using the PLS-5 (Zimmerman et al., 2011) supported a diagnosis of both expressive and receptive language delay (standard score of 76 on the auditory comprehension domain and standard score of 77 on the expressive language domain), however the report indicated that due to a high number of challenging behaviors during the evaluation, receptive language abilities were not adequately assessed. Recommendations included expansion of expressive vocabulary and utterance length.

PROCEDURE

Two studies were completed to address the research aims. The study designs are described below, followed by a description of each of the treatment components and the data collection measures. Both studies employed alternating treatment designs in which

the two language-input conditions (i.e. telegraphic and grammatical) were utilized with each participant. The conditions were alternated to facilitate comparison of treatment effects. The investigator, a graduate student in the department of Communication Sciences and Disorders, completed all assessment measures and treatment sessions.

Study 1. Study 1 included Participant 1 only and served as a pilot study to assure adequate treatment fidelity. It also addressed the third research aim. One-hour sessions were held twice weekly for six weeks. During the first four sessions, Participant 1 completed all of the standardized evaluations, including the PLS-5, Hodson Assessment of Phonological Patterns-3rd edition (HAPP-3; Hodson, 2004) and the Leiter International Performance Scale–Revised (LIPS-R; Roid & Miller, 1997). A mother-child play interaction using a standard set of toys was also completed at each baseline session. The participant's mean length of utterance upon entry to the study (reported above) was calculated from the second two mother-child interactions. The remaining eight sessions included treatment and data collection. Treatment was implemented by two clinicians (one lead clinician and one assistant) and lasted approximately 45 minutes. A total of 10 vocabulary targets were selected from the MacArthur-Bates Communicative Development Inventories database (Dale & Fenson, 1996). Vocabulary words were targeted through focused stimulation (Girolametto et al., 1996). Language input was alternated across sessions (during sessions 1, 3, 5, and 7, telegraphic input was used and during sessions 2, 4, 6, and 8, grammatical input was used).

Study 2. Study 2 included participant 2 only. Participant 2 met all inclusionary and exclusionary criteria. One-hour sessions were held twice weekly for 10 weeks. During the first four sessions Participant 2 completed a standardized evaluation to supplement his initial diagnostic evaluation, including the HAPP-3 (Hodson, 2004) and the LIPS-R (Roid & Miller, 1997). In addition, baseline data on a vocabulary measure

(see data collection) were collected at each of these four assessment-only sessions. The remaining 16 sessions included treatment and data collection. Treatment consisted of 45-minute interactions twice per week for eight weeks using focused stimulation (Girolametto et al., 1996). A total of 20 vocabulary targets were selected from the MacArthur-Bates Communicative Development Inventories (Dale & Fenson, 1996). The vocabulary list was randomly divided into two groups of ten words to be targeted in each of the two treatment phases. In Phase A (weeks 1-4), telegraphic input was used to target the first 10 vocabulary words. During Phase B (weeks 5-8), simple grammatical input was used to target the second 10 vocabulary words.

Focused Stimulation. Focused stimulation procedures were adapted from Girolametto et al., (1996) and Wolfe and Heilman (2010). The therapy room was arranged with multiple sets of play materials that included toys, coloring pages, craft materials, and books for each of the targeted words for the phase. When the participant selected materials, the clinician would engage with the child in a play routine and produce the name of the object or model an action while producing the targeted action word. The clinician was required to produce each target word at least five times per session with a minimum of 50 target word productions per 45-minute session. Sessions varied only in terms of the type of utterances that were modeled by the clinician (telegraphic vs. grammatical).

Telegraphic Input. Telegraphic input procedures were implemented as described by van Kleeck et al. (2010). Vocabulary words were modeled in isolation or within two to three-word utterances that indicated early semantic relationships (Brown, 1973). Examples include nominative (e.g., "That cookie"), agent-action (e.g., "Car go"), and action-object (e.g., "Kick ball") relationships. As illustrated in the examples, morphological markings and articles (i.e. “a” or “the”) were excluded.

Grammatical Input. Grammatical input procedures were implemented as described by Wolfe and Heilman (2010). Target words were presented using simplified, grammatical input consisting in three to four words. Examples of grammatical utterances include "I like eat*ing*", "It*'s a* banana", and "Blow *the* balloon".

TREATMENT FIDELITY

In order to ensure consistent and adequate application of procedural components, fidelity of treatment implementation was measured. Segments from video recordings of randomly selected sessions from both studies were assessed. Coded segments lasted 10 minutes and were initiated exactly 10 minutes after the child entered the room and became visible on the camera. The investigator transcribed all participant and clinician utterances using Systematic Analysis of Language Transcripts (SALT; Miller & Iglesias, 2008) and coded for specific treatment elements (see below). Reliability data for transcription and coding are reported in the Data Analysis section. Fidelity was rated for four of the eight treatment sessions (50%) in Study 1 (two telegraphic and two grammatical sessions) and four of the sixteen treatment sessions (25%) in Study 2 (two telegraphic and two grammatical sessions). Fidelity measures examined both contingency on the child's focus and the use of appropriate language input given the condition (telegraphic or grammatical). Table 1 summarizes fidelity ratings for each of the eight sessions.

Table 1

Fidelity of Intervention Implementation

Study #	Session #	Focused Stimulation		Telegraphic	Grammatical	MLUm
		Contingency	Vocabulary			
1	1	89.1	53	84.8	4.3	1.56
1	3	81.8	33	93.9	3.0	2.21
1	4	88.2	35	5.9	73.5	3.48
1	8	93.3	18	6.7	80.0	3.15
2	1	100	39	64.1	2.6	1.61
2	7	90.4	53	88.5	1.9	1.52
2	9	94.4	39	0.0	80.6	2.98
2	13	100	44	7.1	83.3	2.91

Focused stimulation fidelity. Each of the clinician's utterances containing a target word was transcribed and coded as either contingent or non-contingent on the child's focus of attention. An utterance was considered contingent if the child was looking at the object or event, or was talking about the object or event with the clinician. In addition to contingency, the total number of times the clinician produced each vocabulary target during the 10-minute segment also was tallied. The percentage of contingent clinician utterances ranged from 81.8-100% (mean: 92.95%) across the rated sessions, indicating a high level of clinician contingency. Slightly lower contingency ratings were observed in two sessions of Study 1, which may reflect complications of having two clinicians providing treatment in one session. Based on the requirement that the 10 vocabulary targets be produced at least five times within 45 minutes, production of a minimum of 12 vocabulary words was expected during the 10-minute segments. Target vocabulary words were produced between 18 and 53 times (mean: 39) during the 10-minute interactions, suggesting sufficient production of vocabulary target words.

Language input fidelity. Implementation of telegraphic and grammatical speech conditions was assessed separately. For each utterance containing a vocabulary target a code of telegraphic, grammatical, or reduced grammatical was assigned. Telegraphic utterance codes were assigned to words produced in isolation and two to three-word utterances that expressed semantic relations without including articles, verb inflections, or the copular or auxiliary form of the verb "to be". Examples include utterances such as "dog eat", "cat ball", or "hat on" (e.g. when commenting that the hat *is* on a doll) Grammatical utterance codes were assigned to grammatically correct utterances (complete or partial) that included articles and morphological markers (e.g. verb inflections such as "-ing" or "-ed" or plural "-s"). Examples include "the dog is eating" or "the cat's ball". A number of utterances were deemed appropriate for either language input condition, as they were grammatically correct, but could not be reduced any further to create a telegraphic utterance. These utterances were coded as *grammatically reduced*. Grammatically reduced utterances included mostly descriptive relations, such as "brown bear".

The total percentage of telegraphic, grammatical, and grammatically reduced utterance codes was calculated for each session. As expected during telegraphic sessions, most utterances were coded as telegraphic (mean: 82.83%, range: 64.1-93.9%) and few utterances were coded as grammatical (mean: 2.95%, range: 1.9-4.3%). Similarly, in grammatical sessions, most utterances were coded as grammatical (mean: 79.35%, range: 73.5-83.3%) and few were coded as telegraphic (mean: 4.93%, range: 0-7.1%). A low proportion of utterances coded for the contrasting input condition (e.g. utterances coded as telegraphic during the grammatical phase) for both treatment phases reflects adherence to the language input protocol. The clinician's mean length of utterance in morphemes (MLUm) was not incorporated into the fidelity measure, but is included in Table 1 as a

reference for the reader. As would be expected, in all of the telegraphic input condition sessions, the clinician's MLUm was observed to be lower than in all grammatical input condition sessions (mean for telegraphic: 1.73; mean for grammatical: 3.13). The cut-off between telegraphic and grammatical input MLUm was approximately 2.50.

DATA COLLECTION

Vocabulary Probes. Color images of each of the participants' vocabulary targets were selected for use as probes. For Study 1, 20 vocabulary probes (10 vocabulary targets and 10 non-targets) were presented to Participant 1 at the end of each of the treatment sessions. Data for the vocabulary probes were not collected during the Study 1 baseline sessions due to difficulty identifying 20 unknown vocabulary targets for the participant. For Study 2, all 20 vocabulary probes (10 Phase A vocabulary targets and 10 Phase B vocabulary targets) were presented to Participant 2 during each of the baseline sessions and at the end of each treatment session. Participants were presented with the color images and were asked to name the object or action word depicted. For the noun targets, prompts included "What is this?" and "Look, it's a ____". Prompts for the verb targets included "What is he doing?" and "What happened?"

Clinician-child interaction. Data were collected during the same 10-minute segment that was used to code for fidelity of intervention. The investigator transcribed and coded 10-minute segments from video recordings of the session using SALT (Miller & Iglesias, 2008). In addition to SALT conventions for utterance segmentation and morpheme coding, the investigator coded child and adult productions of target vocabulary words and unintelligible words produced by the child.

In Study 1, 10-minute segments from each of the eight treatment sessions were transcribed and coded. For Study 2, 10-minute segments were transcribed and coded

from eight of the sixteen treatment sessions (one session per week for the eight weeks of treatment). The language samples were obtained during treatment interactions, precluding collection of baseline data for comparison. The following outcome measures were obtained from the coded transcripts:

Total productive words (TPW). TPW was a measure of all words (both intelligible and unintelligible) that the participant produced during the sample

Mean length of the utterances in words (MLUw). MLUw was calculated for all of the child's utterances. Unintelligible words were included in the calculation.

Total verbal turns (TVT). TVT was a measure of the total number of verbal utterances produced by the child during the sample. Incomplete, partially unintelligible, and completely unintelligible utterances were included in this measure.

Imitations (I). Imitations were defined as exact or reduced (words or morphemes deleted) imitations of the adult's prior utterance with no morphemes added.

Vocabulary targets (VT). VT was a measure of the total number of spontaneous and imitative child productions of vocabulary targets during the sample.

DATA ANALYSIS

Visual Analysis. Dependent variables collected during each treatment phase were plotted graphically. Visual analysis was utilized to examine performance patterns. Due to complications involving the vocabulary probe (see Results section), differences in the level of overall vocabulary acquisition and trend of vocabulary growth between conditions could not be determined. For productive language measures, comparisons were made for mean performance within each condition (level) and the consistency of performance. In addition, trends were examined for productive language measures to

identify changes in productivity over time across both language conditions. Due to lack of baseline data, all results must be interpreted with caution.

Reliability. Two undergraduate students in the department of Communication Sciences and Disorders were trained by the investigator to transcribe and code the 10-minute segments used for fidelity ratings and outcome measures. Each undergraduate student independently coded three videos from Study 1 (75% of videos) and 1 video from Study 2 (25% of videos). Proportion of agreement between the investigator and the student for all outcome measures was determined for each session. Variables for which 80% proportion of agreement was not reached initially were reviewed by the investigator for errors in coding. If proportion of agreement did not reach 80% following corrections to coding errors, students reviewed the video along with the investigator and reached a consensus regarding transcription and coding differences. Final proportion of agreement ranged from 0.78 to 1.00. Table 2 summarizes the final proportion of agreement between the investigator and the students for each of the sessions. Proportion of agreement was not calculated for vocabulary targets, imitations, or contrasting speech condition, due to their low rate of occurrence. Instead, the total number of occurrences coded by the investigator and the total number of occurrences coded by the student are indicated. For Study 2, TPW and MLUw were not included as outcome measures (see Results for rationale) and thus reliability data are not included.

Table 2

Inter-rater Proportion of Agreement for Dependent Variables and Fidelity Measures

Study	Session	VT	I	TPW	MLUw	TVT	C	G	T	Target words
1	1	1/1	2/2	0.88	0.88	1.00	0.93	2/2	0.87	0.79
1	2	1/0	1/0	1.00	0.83	0.83	1.00	0.93	0/2	0.88
1	3	2/2	8/8	0.88	0.98	0.86	0.82	1/4	0.94	0.97
1	4	2/2	1/1	0.93	0.88	0.82	0.88	0.86	0/2	1.00
1	6	1/1	3/3	0.95	0.81	0.84	0.94	0.93	0/0	0.94
1	8	0/0	2/4	1.00	1.00	.90	0.86	0.83	0/1	0.78
2	1	2/3	3/3	----	----	0.91	0.91	0/1	0.81	0.91
2	9	0/0	0/0	----	----	0.85	0.94	0.88	0/1	0.98

RESULTS

STUDY 1

Vocabulary. Figure 1 summarizes the performance of Participant 1 on the probe task. None of the probe words were labeled in the initial treatment sessions. By the second session, however, the participant accurately named both targeted vocabulary words and non-targeted vocabulary words. These data suggest that Participant 1 had prior knowledge of at least five of the vocabulary targets (and potentially more) and thus the effects of the focused stimulation treatment on word learning for Participant 1 cannot be determined.

Figure 1

Vocabulary Words Produced During Probes by Participant 1

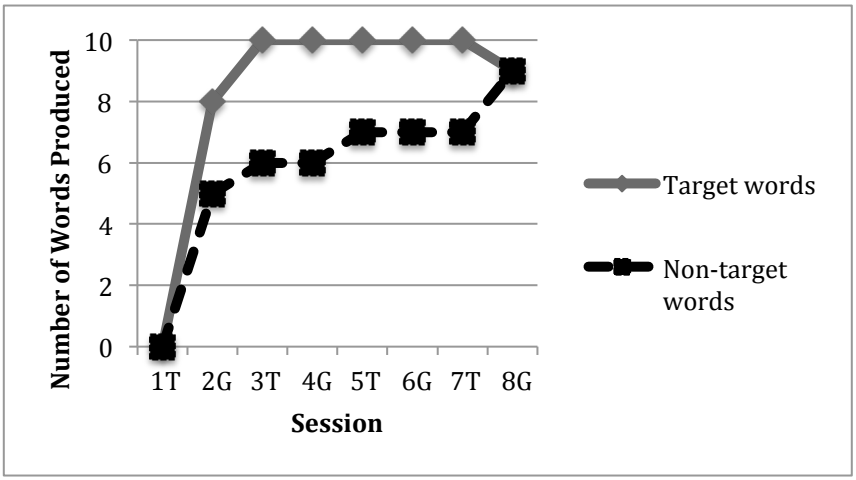
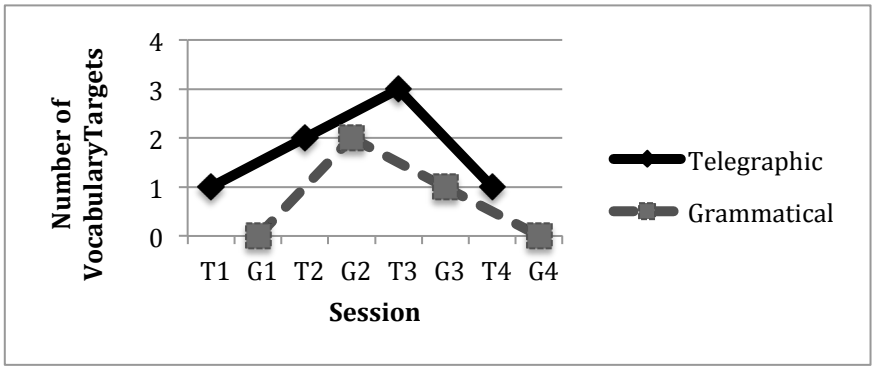


Figure 2 summarizes production of vocabulary targets during each session by Participant 1. The four telegraphic sessions (sessions 1, 3, 5, 7) are represented by the solid line and the four grammatical sessions (sessions 2, 4, 6, 8) are represented by the

dashed line. Participant 1 produced the target vocabulary words between zero and three times during the 10-minute interaction. The participant was more likely to produce a vocabulary target word during the telegraphic input phase (4/4 sessions) than in the grammatical input phase (2/4 sessions). He also produced the highest number of vocabulary targets (3) during a telegraphic input session. Trends across conditions were similar.

Figure 2

Vocabulary Targets Produced During Segments by Participant 1



Language Use. Figure 3 details the total productive vocabulary during the 10-minute segments from each of the treatment sessions for Participant 1. Results from the telegraphic and grammatical sessions are displayed separately. The total productive vocabulary for Participant 1 ranged from 7 to 123 words. The participant demonstrated an increase in total productive vocabulary across the first six sessions and a decrease in total productive vocabulary in the final two sessions. He produced the greatest number of words in the third grammatical session, however, overall variability made it difficult to identify a clear difference in the level of productive vocabulary between telegraphic and

grammatical sessions. In addition to total number of words produced, the length of utterances by Participant 1 was determined. Figure 4 details changes of MLUw across treatment sessions for Participant 1. Small increases were observed across treatment sessions (a positive trend for both conditions), with a decrease in MLUw in the final treatment session (grammatical only). The participant demonstrated an MLUw of 2.0 or higher within more of the grammatical sessions (two of the four) than telegraphic sessions (one of the four); however, MLUw varied across sessions, making it difficult to identify a clear difference in the level of MLUw across conditions.

Figure 3

Total Productive Vocabulary Across Sessions for Participant 1

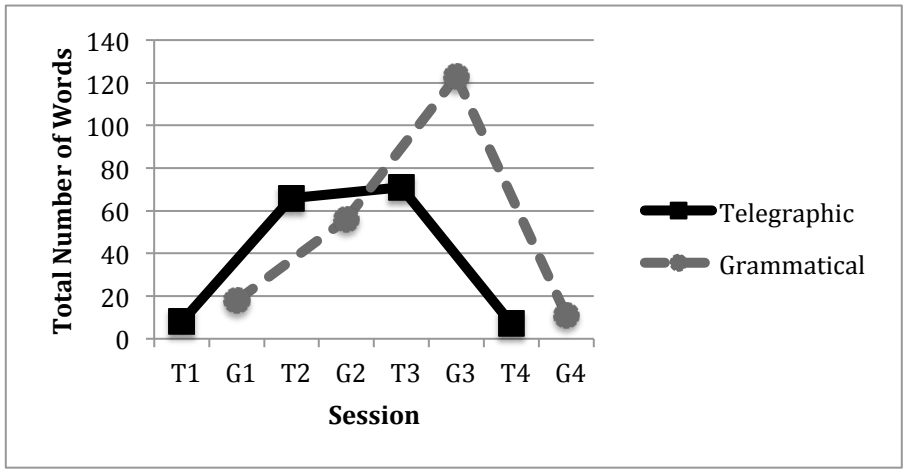
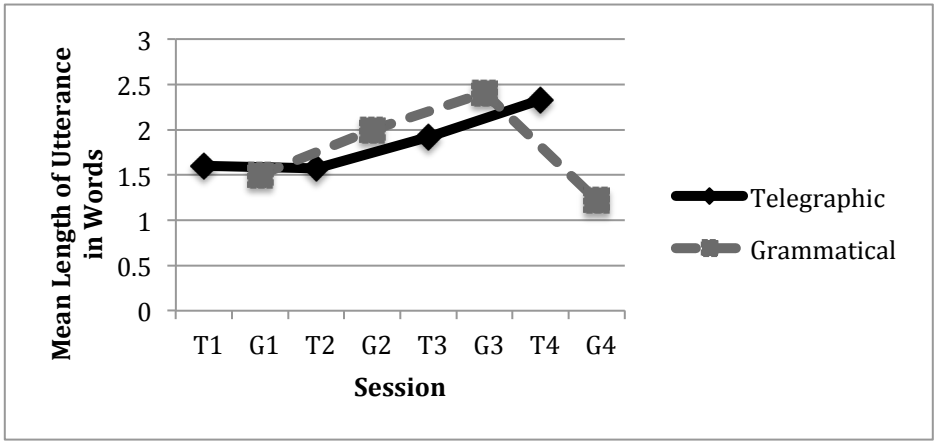


Figure 4

Mean Length of Utterance Across Sessions for Participant 1



Summary: Study 1. Due to the participant's prior knowledge of vocabulary targets as demonstrated by his success in the vocabulary probe during the second session, conclusions regarding word learning could not be determined. Participant 1 was more likely to produce the target vocabulary words during the telegraphic sessions, however. Clear overall differences in language productivity were not observed between telegraphic and grammatical sessions, however, the participant produced the greatest total productive vocabulary in a grammatical session and an MLUw above 2.0 in more grammatical sessions than telegraphic sessions.

STUDY 2

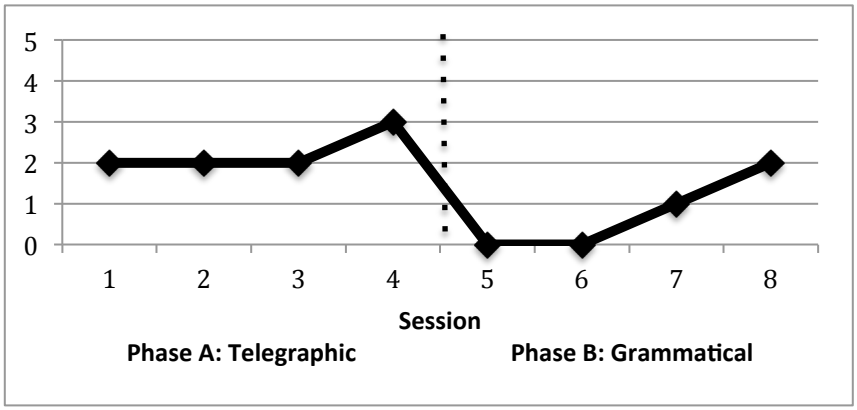
Vocabulary. Participant 2 demonstrated disinterest in the probe task regardless of the format (e.g. computer slideshow, printed cards, fishing set with cards attached to the fish) and reinforcements (e.g. social reinforcement, stickers, preferred toys). He also demonstrated limited intelligibility, leading to difficulty interpreting his attempts to label the target probes. During the course of treatment, the investigator and a supervising

clinically licensed speech language pathologist determined that the expressive language delay exhibited by Participant 2 was greatly impacted by a primary speech sound disorder. Vocabulary probe productions were inconsistent approximations. Specific vocabulary targets attempted varied at each time point, with no demonstration of mastery (i.e. producing the vocabulary word during the probe in one session and then consistently during the probes in all following sessions). Due to unintelligible and inconsistent productions, the results for the vocabulary probe are not presented and no definitive conclusions were made regarding the effect of language input on word learning.

Figure 5 summarizes the production of vocabulary targets by Participant 2 during each session. Participant 2 produced the target vocabulary words between zero and three times during the 10-minute interaction. The participant was more likely to produce a vocabulary target word during the telegraphic input phase (4/4 sessions) than in the grammatical input phase (2/4 sessions). He also produced the highest number of vocabulary targets (3) during a telegraphic input session. Although a difference in level was observed in favor of the telegraphic condition, a greater positive trend was observed in the grammatical phase.

Figure 5

Vocabulary Targets Produced During Segments by Participant 2



Language Use. Participant 2 produced mostly unintelligible jargon speech, making it difficult to determine the exact number of words he produced during treatment sessions (TPV). Instead, the total number of verbal turns taken was included as a measure of productivity. Figure 6 demonstrates changes in the number of verbal utterances produced across treatment sessions. No differences in the total amount of productive language were observed between input conditions. In the telegraphic condition, a negative trend was observed, indicating a decrease in the number of verbal turns across sessions. In contrast, a generally positive trend was observed in the grammatical phase, with a decrease in the final session.

Figure 6

Verbal Turns Taken Across Treatment Sessions by Participant 2

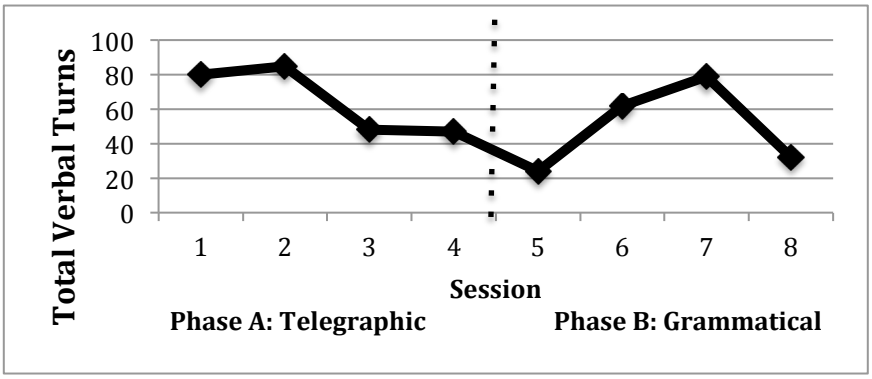
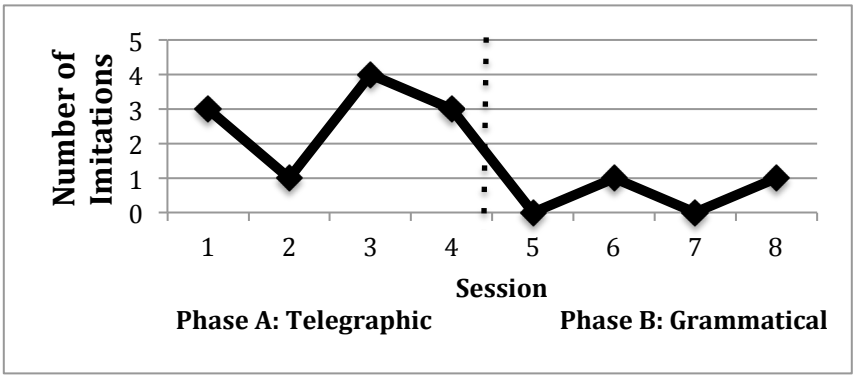


Figure 7 summarizes differences in imitative language produced across sessions. Participant 2 was more likely to imitate the clinician during the telegraphic input phase (four of the four sessions) than in the grammatical input phase (two of the four sessions). He also produced a higher number of imitations (at least three) during three of the four telegraphic input sessions. In the grammatical input phase, the participant produced a maximum of one imitation during the 10-minute coded segment.

Figure 7

Imitations Across Treatment Sessions for Participant 2



Summary: Study 2. Due to the participant's limited intelligibility and inconsistency within the vocabulary probe, data with regard to word learning were not presented. Participant 2 was more likely to produce vocabulary targets during telegraphic sessions, however a more positive trend for vocabulary target production was observed in the grammatical phase. Differences in the level of language productivity were not observed between telegraphic and grammatical sessions. There were trends, however, that are indicative of a decrease in verbal turns across telegraphic sessions and an increase in verbal turns across grammatical sessions. The participant demonstrated a greater likelihood to imitate and an increased number of imitations in the telegraphic sessions.

DISCUSSION

The three-fold purpose of this study was to investigate the type of language input that supports improved word learning, to determine whether differences exist between optimal input conditions for noun and verb learning, and to define the optimal input conditions that facilitate increased language production. Across both studies, participant characteristics limited the conclusions that could be drawn regarding word learning between the two conditions. Yet even in the context of these limitations, there were indications of productive language differences.

The first research aim was to investigate the type of language input that supports improved word learning. In Study 1, the participant entered the study with an elevated baseline vocabulary. Although the 20 vocabulary targets were selected using a parent report measure in which the participant's mother indicated that he did not produce the vocabulary words, it was apparent by the second session that he had prior productive knowledge of at least five of the words (the non-targeted vocabulary), and potentially some of the targeted vocabulary words (although this cannot be confirmed). In Study 2, limited intelligibility and inconsistency within vocabulary probes limited valid assessment of word learning. Focused stimulation therapy is intended for use with children with primary deficits in expressive language and does not incorporate specific strategies to target speech impairments. Participant 2 is likely to benefit more from a treatment approach that focuses on his primary area of concern (i.e. speech intelligibility).

In addition to the vocabulary probe, data were collected for target vocabulary productions within the therapy sessions. Both participants were more likely to produce the target vocabulary words during the telegraphic treatment sessions than during

grammatical sessions. This may reflect improved imitation in the telegraphic input condition (see discussion below). For Participant 2, this observation also may be indicative of enhanced word learning. Importantly, however, differences between spontaneous and imitative productions were not coded, and thus it is unclear whether these productions represent imitations only. In addition, the number of unique words was not determined. In future research, changes to the coding system utilized in this study should incorporate a code that distinguishes between child spontaneous and imitative productions and one that identifies each unique target word. Increases in spontaneous use of multiple vocabulary targets would provide support for the conclusion that the participants acquired the targeted vocabulary words. In Study 2, a more positive trend was noted in the grammatical condition than in the telegraphic condition. This trend may reflect a faster trajectory of improvement or may be a result of changes observed across treatment sessions in the number of verbal turns taken by the participant. Trends in verbal productivity are discussed below.

The second research aim was to determine whether differences exist between optimal input conditions (i.e. telegraphic or grammatical) for noun and verb learning. Due to the limitations with regard to measurement of word learning across both studies, this question could not be answered by these studies. With more rigorous pre-study assessment of subjects and a larger sample, future research could address potential differences in noun and verb learning.

The final aim of the study was to confirm the type of linguistic environment (i.e. telegraphic or grammatical) that facilitates increased language production. Wolfe and Heilmann (2010) suggested that increased language production within sessions could provide increased opportunity for the clinician to recast and expand child language. In contrast to results from the Wolfe and Heilmann (2010) study, clear overall differences in

language productivity were not observed between telegraphic and grammatical sessions for Study 1. It appears that the observed changes in productivity in the first study may have been affected by temporal factors, as productivity increased across initial sessions but decreased in the final two sessions for both input conditions. It is possible that familiarity with the clinicians may have led to initial increases in productivity, whereas decreases in the final two sessions may have been due to a change in meeting time that occurred at session 7. An alternative explanation for the decreases observed may be a diminished interest in the play materials in the final sessions. Although total productivity did not appear to relate to language input factors, Participant 1 demonstrated an MLUw of 2.0 or above in more grammatical sessions than telegraphic sessions. A higher MLUw indicates that the participant was producing a greater number of word combinations. This may be a response to clinician models of lengthier and more complex word combinations. In this case, baseline characteristics of the participant (substantial productive vocabulary and use of some word combinations) most likely supported his ability to match clinician input in the grammatical phase. Although grammatical input may not lead to greater overall productivity, it may support increased use of spontaneous word combinations and thus provide a better language context for therapy targeting early word combinations. Generalization of increased MLUw to non-therapy sessions merits further investigation.

As was determined for Participant 1, there were no clear overall differences in the level of language productivity between telegraphic and grammatical sessions for Participant 2. Interestingly, however, a difference in the trends was observed wherein Participant 2 decreased verbal turn taking across telegraphic session and increased verbal turn taking across the first three weeks of the grammatical input phase. It is important to note that across both studies, trends do not indicate improvement from a baseline, but improvement from the initial session. In the initial grammatical session of Study 2 the

participant demonstrated the fewest number of verbal turns observed in any of the sessions. Room for growth was therefore greater than in the telegraphic sessions and may not reflect differences in the rate of change in verbal productivity. The reduction in verbal productivity observed in the telegraphic phase once again may reflect diminished interest in the play materials utilized during treatment sessions or may be a direct result of clinician input. To enhance the data and interpretation of these trends, future research should investigate longitudinal changes in language productivity as a result of clinician input within a larger sample size. In addition, it is interesting to consider the clinical significance and utility of verbal turn taking for Participant 2. Due to low intelligibility, it was not possible for the clinician to recast and expand most of the child's utterances and thus, a higher number of verbal turns may not be as useful in treatment for Participant 2 as for Participant 1.

A second measure of language use completed for Participant 2 indicated a higher likelihood for him to imitate the clinician and an increased number of imitations in the telegraphic sessions. This finding supports evidence from Willer (1974) that reduced language models are easier to imitate than non-reduced language models. Importantly, however, in the study by Willer (1974), children were required to imitate the clinician in a highly structured setting. In contrast, the present study demonstrates that within naturalistic interactions, a child with expressive language delays was more likely to spontaneously imitate the clinician when language input was reduced. If a higher number of correct imitations leads to improvement in non-imitative productions, as demonstrated by Willer (1974), then telegraphic input may provide a better context than grammatical input for naturalistic word learning therapy. Once again, due to limited evidence of word learning in this study, the topic merits continued research.

Although no concrete demonstration of word learning was observed in either study, productive language differences were observed across language input conditions for both participants. Specifically, the participant with elevated baseline productive language demonstrated a higher mean length of utterances during grammatical sessions, and the participant with reduced expressive language abilities at the onset of treatment demonstrated higher likelihood to imitate within telegraphic sessions. Participant 2 also demonstrated negative trends for verbal turn taking and production of vocabulary targets. The results support the need for careful selection of language input protocols based on initial client abilities and treatment outcome goals. In addition, limitations to the current investigation underscore the importance of systematic study of language input factors. Future research in this area should include a greater number of children with a more clearly defined initial speech and language criterion level. In addition, more sophisticated research designs should be utilized that allow for comparisons across subjects, a comprehensive baseline assessment phase, and control for the order of treatment conditions. Due to the prevailing view that use of telegraphic speech over time may inhibit grammatical development (van Kleeck et al., 2010), longitudinal observations should be incorporated to indicate long-term effects of language input within therapy sessions on overall receptive and expressive language abilities.

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